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OSMB Final Report, Task 7: Online Atlas of Oregon Lakes - Aquatic Invasive Species Interface

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Final report submitted to the Oregon State Marine Board

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Abstract

In order to educate a broad cross section of the public about Aquatic Invasive Species (AIS) distributions and survey efforts in Oregon's lakes and reservoirs, database connections were created to display AIS information on the Online Atlas of Oregon Lakes (aol.research.pdx.edu/). The connections allowed for the dynamic display of AIS survey records stored in three separate databases: the Center for Lakes and Reservoir's Oregon Aquatic Plant and Mussel Databases and the *i*MapInvasives database. AIS survey records collected by the Center for Lakes and Reservoirs were also reported to the *i*MapInvasives database.

Introduction

Aquatic invasive species (AIS) such as zebra and quagga mussels (*Dreissena* spp.) and hydrilla (*Hydrilla verticillata*) cause significant ecological and economic harm in the US (Pimentel et al. 2005). While these plant and animal species have not been detected in Oregon's waters, other AIS such as Brazilian elodea (*Egeria densa*) and Eurasian watermilfoil (*Myriophyllum spicatum*) are locally abundant and interfere with beneficial uses such as boating, fishing, and drinking water supply.

Recognition of these impacts lead to the formation of Oregon Invasive Species Council in 2001 and the AIS Prevention Program in 2009. A high priority of both programs is public education and outreach about the impacts of AIS, practices to reduce their introduction and spread, and providing information about the status of AIS in Oregon (Reesman et al. 2014). AIS distribution information is currently available through several online sources. For example, *Dreissena* spp. monitoring results are available on Portland State University's Online Mussel Monitoring Map (mussels.geos.pdx.edu/) and the USGS Nonindigenous Aquatic Species program website (US Geological Survey 2014). Other animal and plant AIS distribution data are available through the Nature Conservancy's *i*MapInvasives website (NatureServe 2014), the Oregon Department of Agriculture's Oregon WeedMapper website (Oregon Department of Agriculture 2014), and the USGS Nonindigenous Aquatic Species program website (US Geological Survey 2014).

While these websites are very important vehicles for disseminating AIS information, visitors to the sites are most likely *looking* for more information about AIS. The goal of this project was to reach a broader section of the public with information about AIS in Oregon's lake and reservoirs. The Online Atlas of Oregon Lakes (OAOL) (aol.research.pdx.edu/) was selected as a vehicle for spreading AIS information to the broader audience. The OAOL is an updated and expanded version of the Atlas of Oregon Lakes (Johnson et al. 1985) that provides information of interest to the public on selected lakes and reservoirs including general descriptions, access and land ownership maps, bathymetric maps, water quality information, details about boat ramps, lake pictures, and links to Oregon Department of Fish and Wildlife fishing reports (Lycan et al. 2012).

Project goals were accomplished by 1) creating connections between the OAOL and several AIS distribution databases including *i*MapInvasives, 2) displaying the AIS distributions on the OAOL, 3) presenting general information and links about AIS, and 4) submitting new AIS records to the *i*MapInvasives database.

AIS databases and connections to the OAOL

The heart of this project was creating the connections between the OAOL database and the three databases that contain AIS survey results. Two of the three AIS databases are maintained by

PSU-CLR, the third is maintained by Oregon Biodiversity Information Center (OBIC) at PSU. The two PSU-CLR databases, the Mussel Database and the Oregon Aquatic Plant Database (ORAPD), are linked to the OAOL database using their National Hydrography Dataset (NHD) Waterbody Reachcode Identifier. The NHD is a digital vector dataset that is maintained by the USGS that represents the nation's surface waters for use in Geographic Information Systems (Simley and Carswell Jr. 2009). Each geometric shape representing a waterbody in the NHD is assigned a unique and permanent Waterbody Reachcode Identifier. The OAOL uses the NHD geometric shapes to represent lake and reservoirs on the website and uses the Waterbody Reachcodes for identification. Waterbody Reachcodes were added to survey records stored in the two PSU-CLR databases so they could be easily linked to the OAOL.

Since we did not have the ability manipulate the database structure in the *i*MapInvasives database, and since the database does not use NHD Waterbody Reachcodes, we were not able to use the identifiers to link database records to the OAOL. The *i*MapInvasives database records, however, does include latitude and longitude so we were able to spatially join the records to the OAOL database.

OAOL Database
The OAOL is a PostgreSQL database structured around the NHD. The OAOL uses the NHD geometric shapes to represent lake and reservoirs on the website and uses the Waterbody Reachcode Identifiers and the primary identifiers in the database. The Waterbody Reachcode Identifier are used to link to information such as photos, maps pertaining to a particular lake, documents about the lake, and other information.

Oregon Aquatic Plant Database
The PSU CLR ORAPD database is a Microsoft Access database based on Washington State Department of Ecology's Aquatic Plant Survey database (WADOE 2014). The ORAPD includes tables with information about plant survey locations, dates, surveyors, and results. A database query called "AOL_export" is used to produce a text file that is sent to the OAOL and linked via the Waterbody Reachcode Identifiers. The text file is sent periodically for upload to the OAOL database as ORAPD data are appended or edited. The query includes all necessary information for display on the OAOL (Figure 1). The ORAPD currently includes 3653 plant records collected from 115 unique water bodies. The database includes observations of 139 aquatic species, 21 of which are non-native to Oregon.

WaterbodyName	Scientific Name	CommonName	NativeSpecies	NoxiousWeedDesignation	ObsDate	SurveyOrg	ReachCode	Lat_DD	Lon_DD
Lippert Pond	Eleocharis acicularis	needle spikerush	☑		8/30/2012	PSUCLR	17100309003769	42.27328	-123.26221
Lippert Pond	Zannichellia palustris	horned pondweed	☑		8/30/2012	PSUCLR	17100309003769	42.27449	-123.26433
Lippert Pond	Myriophyllum spicatum	Eurasian watermilfoil	☐	B	8/30/2012	PSUCLR	17100309003769	42.27322	-123.26331
Lippert Pond	Myriophyllum spicatum	Eurasian watermilfoil	☐	B	8/30/2012	PSUCLR	17100309003769	42.27307	-123.26146
Lippert Pond	Potamogeton sp.	pondweed	☑		8/30/2012	PSUCLR	17100309003769	42.27449	-123.26433
Lippert Pond	Myriophyllum spicatum	Eurasian watermilfoil	☐	B	8/30/2012	PSUCLR	17100309003769	42.27329	-123.26056
Lippert Pond	Myriophyllum spicatum	Eurasian watermilfoil	☐	B	8/30/2012	PSUCLR	17100309003769	42.27342	-123.26057

Figure 1. Example records from an ORAPD AOL_Export query

PSU CLR Mussel Database
The PSU CLR mussel database is a MySQL database that contains results of field surveys conducted by PSU CLR and others. Results are primarily from three types of surveys: *Dreissena* spp. veliger (the planktic stage of the mussels' lifecycles) net tows, adult *Dreissena* spp. mussel and Asian clams (*Corbicula fluminea*) artificial substrate monitoring results, and opportunistic sampling methods such as inspecting rocks, docks and other hard substrates. To streamline data

entry, an administrative interface to the mussels data was built to allow observations to be uploaded using a spreadsheet. Add/edit/delete functionality was built for species, reporting agencies, substrate types, water bodies and users (Figure 2). The database is updated on at least a semi-annual basis.

Figure 2. PSU CLR Mussel data entry form

iMapInvasives Database

*i*MapInvasives is an invasive species reporting and data management tool developed by the Nature Conservancy, NatureServe, and other collaborators. The Oregon portion of *i*MapInvasives is managed by the Oregon Biodiversity Information Center at Portland State University (obic.pdx.edu). Records of 16 different AIS plant species from nearly all Oregon counties are present in the *i*MapInvasive database (accessed 04/04/2014). Ten different survey collection organizations are represented including CLR, the Bureau of Land Management, US Forest Service, and the US Geological Survey. Data from various collectors have also been provided to *i*MapInvasives through the Oregon Flora Project (2014) and the Oregon Invasive Species Hotline (oregoninvasiveshotline.org).

Presentation of AIS survey results

Survey results are presented by navigating to a lake of interest and clicking on the lake to get a series of menus on the browser. Aquatic plant survey result are viewed by selecting the "Plants" menu item. The browser will show a description of the data sources, an explanation of the Oregon Department of Agriculture's Noxious Weed List, and survey results for the particular lake (Figure 3). Survey results list the date(s) of survey, the species encountered, the native/non-native/noxious status of each species, and the source of the survey information. The latitudes and longitudes of sample collection locations are not included to preclude identification of the exact locations of invasive or rare species. Users are also able to download sampling results from a waterbody as a .csv file by clicking on the link provided below the data display.

Mussel and clam survey results are viewed by selecting the "Molluscs" menu item. The browser will show date of the survey, the status of the survey or the species observed, and the source of the survey information (Figure 4). In addition to any positive results for *Dreissena* spp. (none in

Oregon as of 4/11/2014) or *Corbicula fluminea*, the status of surveys may include "non-detect" if a survey was conducted and *Dreissina* spp. were not found and "results pending" if a sample had been collected by had not been analyzed. Mussel and clam sampling results are not downloadable through the OAOL as is the case with the aquatic plant sampling results; rather, users are provided a link to the Online Mussel Monitoring Map for more detailed information.
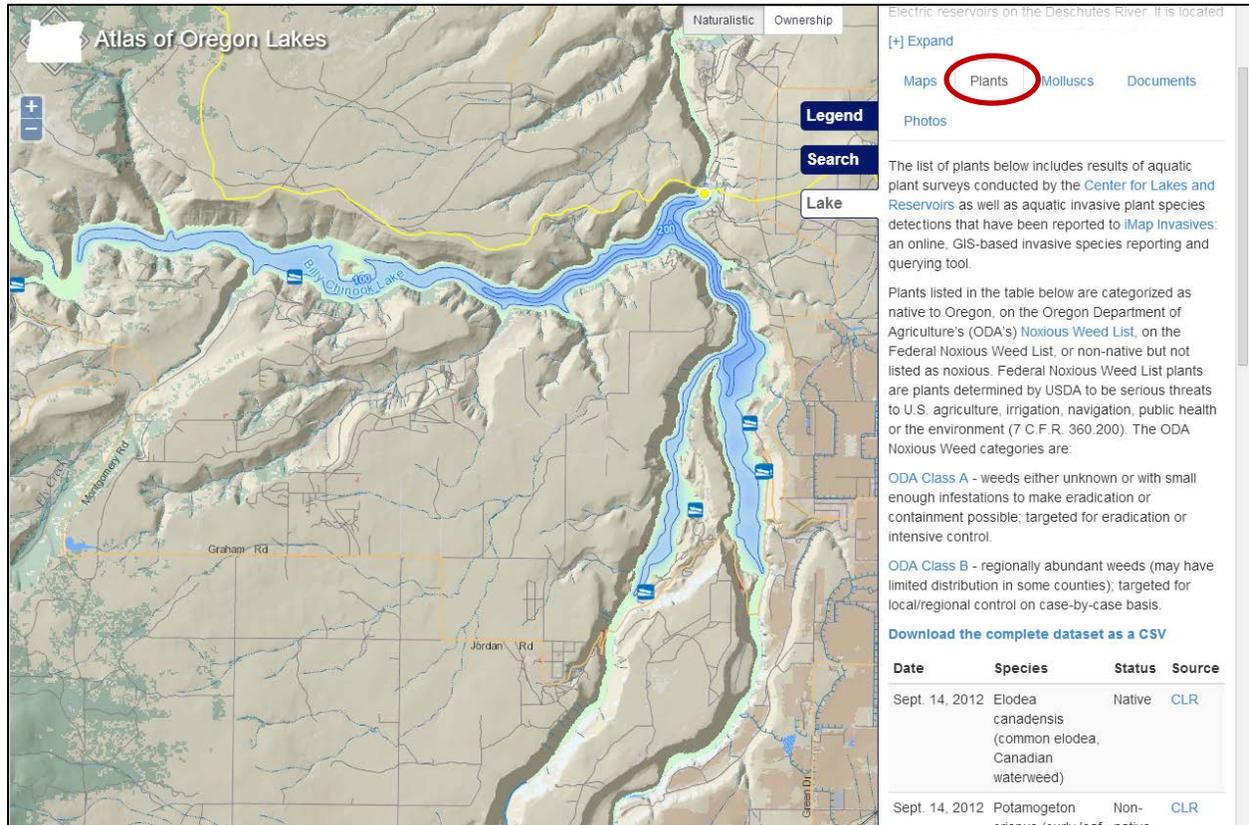

Figure 3. Aquatic plant survey results for Lake Billy Chinook as presented on the OAOL.
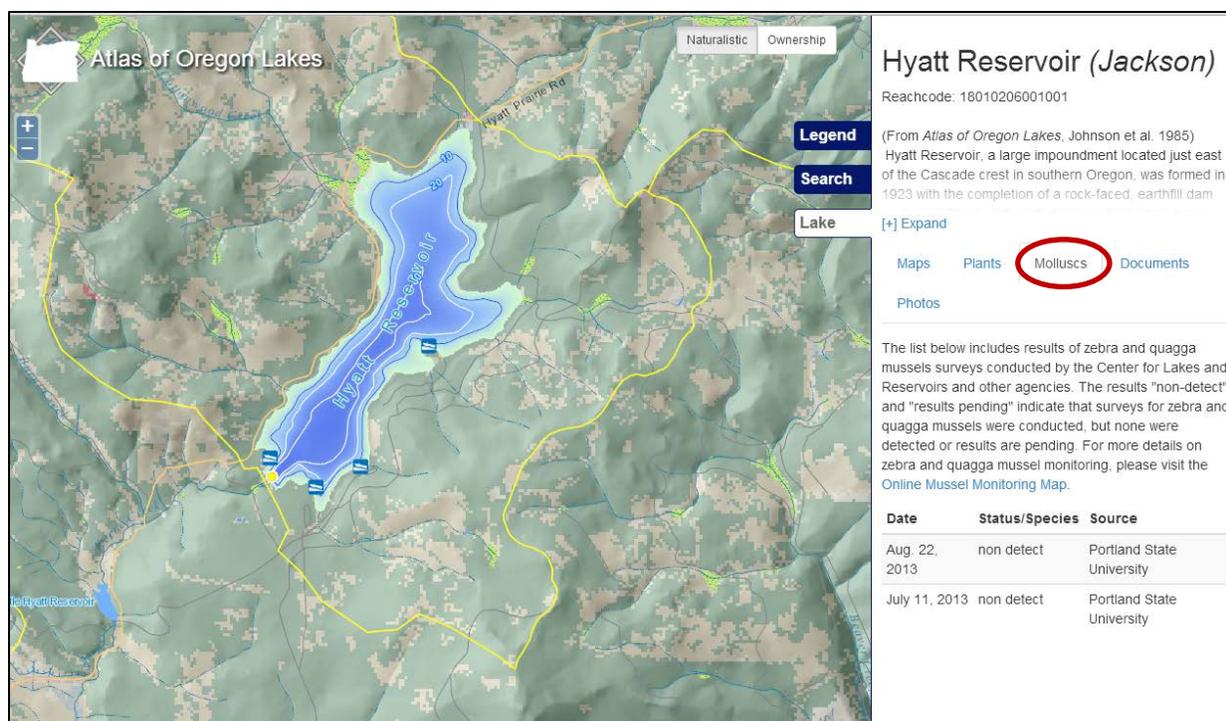
Figure 4. Example of *Dreissina* spp. monitoring results Displayed on the OAOL.

Table 1. Example Aquatic plant survey results download output from the OAOL.

NHD Reachcode	Lake Name	Obs. Date	Plant Name	Plant Common Name	Noxious Weed Designation	Is Native	Source	Survey Organization
17070301004153	Lake Billy Chinook	1/1/1999	*Iris pseudacorus*	yellow flag iris	B	FALSE	IMAP	USGS
17070301004153	Lake Billy Chinook	9/14/2012	*Elodea canadensis*	Canadian waterweed		TRUE	CLR	PSUCLR
17070301004153	Lake Billy Chinook	9/14/2012	*Potamogeton crispus*	curly leaf pondweed		FALSE	CLR	PSUCLR
17070301004153	Lake Billy Chinook	9/14/2012	*Stuckenia filiformis*	slender leaved pondweed		TRUE	CLR	PSUCLR
17070301004153	Lake Billy Chinook	8/21/2012	*Ceratophyllum demersum*	Coontail; hornwort		TRUE	CLR	PSUCLR

Presentation of general AIS information

General information and links to details about AIS is presented on the main page of the OAOL as well as a pop-up window from individual lake pages (Figure 5). Information includes how to report an AIS, practices to prevent the spread of AIS, volunteer AIS survey opportunities, and a wide range of other AIS links.

Submissions to *i*MapInvasives

Observations of AIS by PSU CLR that are in the OPAPD were submitted to *i*MapInvasives. These observations include records of 8 AIS species from 19 waterbodies throughout Oregon.

Summary and discussion

We were able to successfully link three AIS databases to the OAOL and dynamically display distribution data and other AIS information on the website. The presentation of this information on the OAOL gives more visibility to the issues of AIS in our lakes, provide quick access for

resource managers to AIS and other related lake information, and highlights the iMapInvasives website.

Information about Aquatic Invasive Species in Oregon.

The Online Atlas of Oregon Lakes (OAOL) is committed to helping reduce the risk of the introduction and spread of Aquatic Invasive Species (AIS). We believe this can be accomplished through a public that is well informed on how Clean-Drain-Dry and other practices can reduce the spread of AIS, how to keep an eye out for AIS, how to report suspicious species, and the waterbodies that are infested with AIS. Funding for presenting AIS distribution data and other AIS information on the Online Atlas of Oregon Lakes was provided through the Oregon State Marine Board's AIS Prevention Program. Links to a wealth of information about AIS are provided below.

AIS Reporting. If you think you've found an AIS in Oregon, please report your finding to the

- Oregon Invasive Species Online Hotline, 1-866-INVADER

AIS Prevention. For tips on how to prevent the introduction and spread of AIS, as well as rules and regulations about AIS transport, visit the

- Protect Your Waters website
- 100th Meridian Initiative's decontamination page
- or the Oregon State Marine Board AIS Prevention Program webpage and Clean Boaters Guide

Volunteer Opportunities. If you would like to get involved with surveys for high priority AIS in Oregon, visit the Portland State University Center for Lakes and Reservoirs'

- Oregon Lake Watch Program website
- and the Zebra and Quagga Mussel Monitoring Program webpage

Other AIS Information. Finally, if you would like to find out more details about the current distributions of AIS or other general AIS information, visit

- iMapInvasives
- 100th Meridian Initiative
- Oregon Department of Fish and Wildlife
- Early Detection and Distribution Mapping System
- Oregon WeedMapper
- the Oregon Invasive Species Online Hotline website
- the Oregon Department of Agriculture Noxious Weed Program website
- the Oregon Invasive Species Council website (oregoninvasivespeciescouncil.org)
- the Oregon Flora Project (www.oregonflora.org/atlas.php)
- and the United States Geological Survey Nonindigenous Aquatic Species information resource

Figure 5. AIS general information and links page presented on the OAOL.

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